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Évaluation de la pompe personnelle SKC, modèle 224-PCXR7

Pierre Larivière
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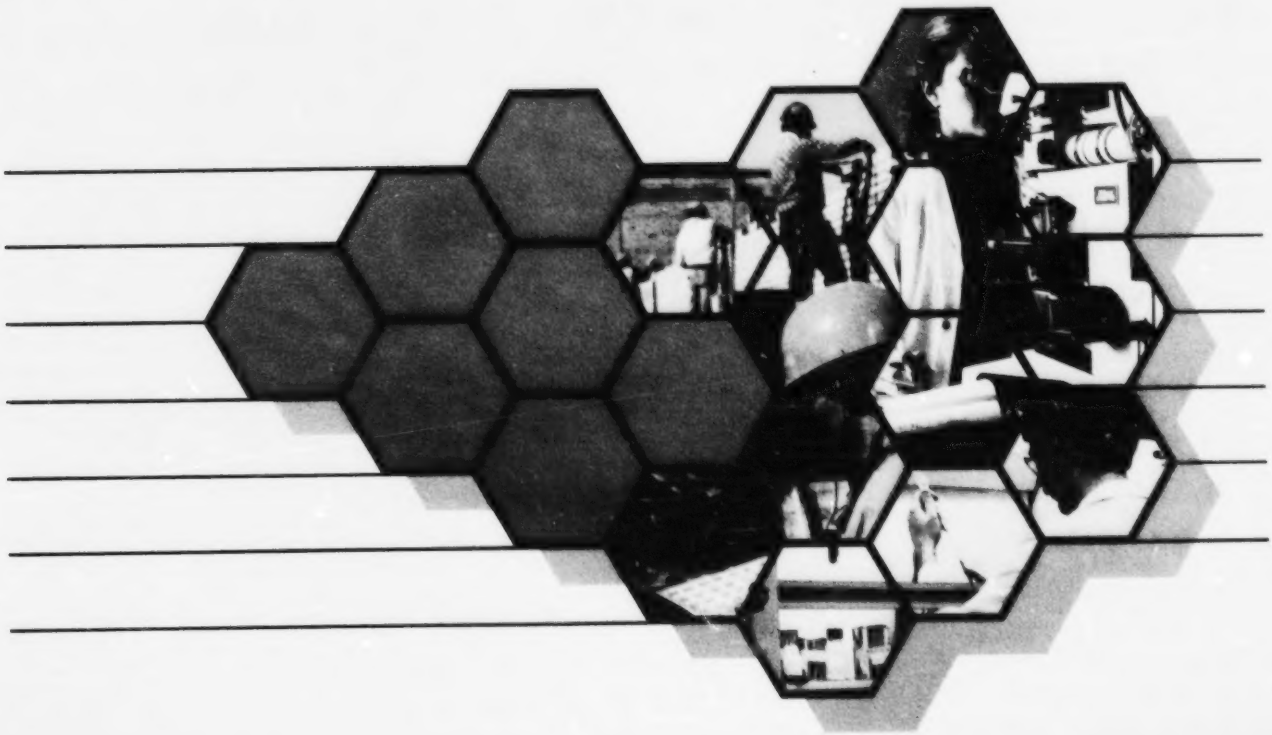
Programme soutien analytique
Direction des laboratoires
IRSST

Juin 1988

Méthode de laboratoires



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MÉTHODE DE LABORATOIRES

ÉTUDE TECHNIQUE

ÉVALUATION DE LA POMPE PERSONNELLE SKC MODÈLE 224-PCXR7

Pierre Larivière
Lambert Laliberté
Programme soutien analytique
Direction des laboratoires

"Cette étude a été financée par l'IRSST. Les conclusions et recommandations sont celles des auteurs".

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Annexe I: Livre d'instructions de la pompe SKC modèle 224-PCXR7

1. INTRODUCTION

L'évaluation constante de la technologie a fait apparaître sur le marché des nouveaux types de pompes personnelles d'échantillonnage plus performantes et munies d'un grand nombre de fonctions programmables.

Conscient du besoin d'améliorer sans cesse la qualité du prélèvement il devient important d'évaluer ces nouveaux produits afin de recommander des achats judicieux.

Le présent document contient les résultats de l'évaluation de la pompe SKC, modèle PCXR7 réalisée selon la procédure d'évaluation des pompes personnelles d'échantillonnage de l'IRSST (1).

Suite à une brève description de la pompe, on retrouve les résultats d'évaluation des critères d'acceptabilités, des spécifications et options propres à la pompe et le manuel d'utilisation.

Les corrections et/ou modifications à apporter à la pompe de même que des précautions quant à son utilisation sont décrites dans la section conclusion/recommandations.

La pompe (# de série 502217) et les accessoires nous ont été fournis par le distributeur Dur-Pro Filtration*, de Brossard. Les accessoires comprenaient une valise de transport, un support à cassette, un ensemble de trois tournevis, un chargeur simple (224-31SCR), un chargeur multiple (224-32SCR), un raccord de sortie d'air externe, quatre échantillonneurs ajustables (224-26-01 à 04) et trois couvres-tubes (224-28A).

* Dur-Pro Filtration, 3070 boul. de Rome, Brossard, Québec J4Y 1V9

2. DESCRIPTION DE LA POMPE

Cette pompe à débit constant a une plage d'utilisation qui s'étend de 1 à 5000 mL/min. Elle peut fonctionner sur deux modes: bas débit (1 à 750 mL/min) et haut débit (750 à 5000 mL/min). Elle est constituée de 2 diaphragmes et amortisseurs de pulsations en silicone actionnés par un moteur DC. La pompe est alimenté par une batterie de cinq cellules NiCd branchées en série fournissant une capacité de 2 ampères-heures.

Le débit constant est assuré électroniquement par une boucle de "feedback" en corrigeant le voltage au moteur et peut être compensé pour une chute de pression jusqu'à 40 pouces d'eau à 2 litres/minutes. En mode "bas débit", un régulateur de pression maintient une pression de 20 pouces d'eau.

Le panneau de contrôle est constitué d'un affichage à cristaux liquides et d'un clavier pour la programmation de la pompe et la vérification de l'état de la batterie. Le débit est visualisé à l'aide du rotamètre intégré dans la pompe.

3. RÉSULTATS

3.1 Évaluation des critères d'acceptabilités

3.1.1 Critères généraux

3.1.1.1 Dimension

Les dimensions d'ensemble de la pompe ne doivent pas excéder:

14 cm en hauteur
14 cm en largeur
7 cm en profondeur

Résultat: La pompe rencontre ce critère.

Remarque: Les dimensions d'ensemble sont:
hauteur maximum : 13.3 cm
largeur maximum : 13.2 cm
profondeur maximum: 5.95 cm

3.1.1.2 Poids

Le poids de la pompe (avec bloc d'alimentation) ne doit pas dépasser 1000 g.

Résultat: La pompe rencontre ce critère

Remarque: Le poids de la pompe est de 977,2 g.

3.1.1.3 Assemblage / Construction

Le boîtier de même que tous les composants de la pompe sont faits de matériaux résistants à la corrosion et assemblés de façon étanche afin de minimiser la quantité de poussières pouvant entrer dans le boîtier.

Résultat: La pompe rencontre ce critère.

Remarque(s):
- le boîtier manque de finition (bavures de plastique);
- mauvais alignement des 4 vis du bloc d'alimentation.

3.1.1.4 Interrupteur

La pompe sera munie d'un interrupteur marche/arrêt ou d'un dispositif équivalent à l'extérieur du boîtier. Cet interrupteur sera à l'abri d'une fausse manoeuvre durant l'usage et à l'abri des poussières, pour éviter de contaminer le mécanisme.

Résultat: La pompe rencontre ce critère.

3.1.1.5 Ajustement du débit

La pompe doit être munie d'un dispositif adéquat pour l'ajustement du débit, accessible de l'extérieur du boîtier, mais protégé contre un déréglage accidentel. Le mécanisme d'ajustement nécessite l'utilisation d'un outil.

Résultat: La pompe rencontre ce critère.

Remarque(s):
- beaucoup d'hystérésis dans l'ajustement du débit;
- le trou d'ajustement du débit est trop petit pour la lame du tournevis fourni.

3.1.1.6 Bloc d'alimentation

Le bloc d'alimentation sera situé dans le boîtier de la pompe ou dans un boîtier séparé, rattaché au boîtier de la pompe via une connexion électrique approuvée. Le bloc d'alimentation devra de plus posséder un dispositif de protection contre les court-circuits et/ou un dispositif automatique d'interruption réutilisable.

Résultat: Le bloc d'alimentation ne rencontre pas ce critère.

Remarque: Le dispositif de protection contre les court-circuits et/ou dispositif automatique d'interruption n'est pas réutilisable; cependant de part la conception de la prise de raccordement du chargeur, il est presque impossible de court-circuiter le bloc d'alimentation.

3.1.1.7 Agrafe à ceinture

La pompe sera munie d'une agrafe à ceinture qui maintiendra la pompe solidement attachée à la ceinture du travailleur.

Résultat: La pompe rencontre ce critère.

Remarque: À haut débit l'agrafe se met à vibrer (échantillonnage en air ambiant).

3.1.1.8 Fiche de raccordement du chargeur

Une fiche adéquate doit permettre de recharger le bloc d'alimentation sans le retirer de son boîtier ou du boîtier de la pompe.

Résultat: La pompe rencontre se critère.

3.1.1.9 Indicateur de débit

Un indicateur visuel du débit sera partie intégrante de la pompe indiquant le débit d'air traversant la tête de prélèvement. L'échelle sera indiquée au L/min avec des divisions au 250 mL. L'exactitude devra être supérieure ou égale à ± 10 % jusqu'à un débit de 2 L/min.

Résultat: La pompe rencontre ce critère.

3.1.1.10 Trappe à liquides

La pompe doit posséder à l'entrée d'air une trappe afin d'empêcher les solutions liquides accidentellement aspirées de contaminer le mécanisme de la pompe.

Résultat: La pompe rencontre ce critère.

3.1.1.11 Filtre à poussières

La pompe doit posséder à l'entrée d'air un filtre afin d'empêcher les poussières de contaminer le mécanisme de la pompe.

Résultat: La pompe rencontre ce critère.

3.1.1.12 Chargeur

Le chargeur du bloc d'alimentation doit posséder deux (2) modes de charge et changer automatiquement de mode (charge à courant d'appoint) lorsque la charge est terminée. Les courants utilisés ne devront en aucun cas causés une augmentation de température excédant 50°C de façon continue. Le courant d'appoint doit se situer entre C/80 et C/100 (C étant la capacité de la batterie).

Résultat: Le chargeur ne rencontre pas ce critère.

Remarque(s):
- le courant d'appoint est beaucoup trop élevé (103 mA), il devrait être de 20 à 25 mA;
- la fiche de charge se débranche facilement si la pompe culbute par en arrière;
- la minuterie du chargeur n'est pas adéquate (ne charge que 3 heures);
- les 2 broches de la fiche du chargeur sont exposées à l'air risquant de provoquer un court-circuit et/ou leur bris;
- le lettrage sur l'étiquette enroulé autour du fil s'efface facilement.

3.1.1.13 Sortie d'air interne

La pompe doit avoir une sortie d'air à l'intérieur du boîtier, afin de maintenir une légère pression positive qui réduira l'entrée des contaminants dans le boîtier de la pompe.

Résultat: La pompe rencontre ce critère.

3.1.1.14 Approbation sécuritaire

La pompe doit être approuvée par un laboratoire reconnu pour les classes suivantes:

Classe I (Code T3C) : groupe A, B, C, D
Classe II : groupe E, F, G
et Classe III

L'indication de cette approbation doit être apposée sur le boîtier de la pompe et le bloc d'alimentation.

Résultat: La pompe rencontre ce critère.

3.1.1.15 Garantie

La garantie doit être supérieure à une année et couvrir toutes les pièces de la pompe et la main-d'oeuvre.

Résultat: La pompe rencontre ce critère.

Remarque: La garantie n'est pas très explicite.

3.1.2 Critères mécaniques

3.1.2.1 Plage d'utilisation du débit

Le débit de la pompe doit être ajustable entre:
25 et 500 mL/min pour une pompe à bas débit, et/ou;
1000 à 2000 mL/min pour pompe à haut débit.

Résultat: La pompe rencontre ce critère.

3.1.2.2 Uniformité du débit

Le débit de la pompe ne doit varier de plus de ± 5 % du point d'ajustement sous les conditions suivantes:

Débit (mL/min)	**Température** (°C)	**Chute de pression** (cm H_2O)	**Durée de l'essai** (heures)
200	- 15	51	8
	+ 45	51	8
	- 15 à + 45	51	-
2000	- 15	51	8
	+ 45	51	8
	- 15 à + 45	51	-

Résultat:
- à température fixe (-15 et +45°C), la pompe rencontre ce critère;
- à température variable (de -15 à +45°C), la pompe ne rencontre pas ce critère.

Remarque(s):
- pour l'essai où la température varie de -15°C à +45°C, on obtient par la mesure de la fréquence de pulsation une variation de débit de 24 % du point d'ajustement;
- on observe des variations brusques du débit dans le temps. Ces variations dure peu de temps et atteignent jusqu'à 2 % du point d'ajustement;
- en mesurant l'aire sous chaque courbe de pulsation, nous avons relevé une différence de symétrie entre les 2 chambres à piston.

3.1.2.3 Autonomie de la pompe

La pompe devra pouvoir fonctionner pendant au moins huit (8) heures sous les conditions suivantes:

Débit (mL/min)	**Température** (°C)	**Chute de pression** (cm H_2O)
200	- 15	51
2000	- 15	51

Résultat: La pompe rencontre ce critère.

Remarque: La pompe a fonctionné 11 heures à -14°C.

3.1.2.4 Pulsations

L'irrégularité du débit due aux pulsations, aura une fréquence fondamentale supérieure à 20 Hz.

Résultat: La pompe rencontre ce critère.

3.1.2.5 Niveau de pression sonore

Le niveau de pression sonore (en dB(A)) le plus élevé enregistré à l'une des six (6) faces de la pompe, ne doit pas dépasser 60 dB(A).

Résultat: La pompe rencontre ce critère.

Remarque: Le niveau le plus élevé rencontré à l'une des six faces est de 57.1 dB(A).

3.1.2.6 Sortie d'air externe

La pompe doit être munie d'un raccord de sortie d'air et fournir un débit égal et/ou supérieur à la moitié du débit à la tête d'échantillonnage.

Résultat: La pompe rencontre ce critère.

Remarque: En fonctionnant dans ce mode l'intérieur de la pompe n'est plus à pression positive.

3.2 Validation des spécifications et évaluation des composantes et options

3.2.1 Compensation pour une chute de pression

Résultat: La pompe ne répond pas à cette spécification.

Remarque: La compensation pour une chute de pression à 2,5 litres (40 pouces d'eau) et 5 litres (15 pouces d'eau) ne rencontre pas les spécifications du manufacturier.

3.2.2 Minuterie à affichage à cristaux liquides

Résultat: Cette composante fonctionne adéquatement.

3.2.3 Détecteur de blocage du débit

Résultat: Cette composante fonctionne adéquatement.

3.2.4 Indicateur de la capacité du bloc d'alimentation

Résultat: Nous ne pouvons pas nous prononcer sur cette composante.

Remarque(s):
- l'indicateur s'éteint à un voltage de 6.45 volts, soit 1.29 V/cellule;
- théoriquement, ce voltage de détection garantie une utilisation de 8 heures si l'on se réfère à la courbe de décharge d'une cellule de format C et de capacité de 2.0 Ah de la compagnie General Electric.

3.2.5 Pause d'échantillonnage

Résultat: Cette composante fonctionne adéquatement.

3.2.6 Programmation (temps d'arrêt et échantillonnage intermittent)

Résultat: Cette option fonctionne adéquatement.

3.2.7 Chargeur multiple

Résultat: Cette option ne fonctionne pas adéquatement.

Remarque(s):
- le courant d'appoint est trop élevé (90.6 mA); il devrait être de 20 à 25 mA.
- le mode qui inclut la décharge de la batterie est très intéressant.

3.2.8 Collecteur multiple

Résultat: Cette option fonctionne adéquatement.

Remarque: Il n'y a pas de couvert protecteur sur une des vis d'ajustement du collecteur triple.

3.2.9 Support à cassette

Résultat: Cette option fonctionne adéquatement.

Remarque: Le support n'accepte que les cyclones SKC

3.3 Évaluation du manuel d'utilisation

La lecture complète du manuel d'utilisation du manufacturier est effectuée pour déterminer si le manuel décrit de façon adéquate les avantages, options et fonctions de l'instrument en question. Un manuel complet doit inclure des instructions pour:

1) la révision
2) l'utilisation
3) la réparation
4) l'entretien

Le manuel est évalué à l'aide d'un examen de trente (30) questions. Chacune des questions est cotée de 0 à 2 points (0 = insatisfaisant, 1 = passable et 2 = satisfaisant), puis le tout cumulé pour un total, lui-même subdivisé en trois (3) catégories:

1) 54 points et plus, excellent
2) 36 à 53 points, adéquat
3) 35 points et moins, pauvre

QUESTIONNAIRE D'ÉVALUATION

		Cote d'évaluation
1.	Le manuel est-il rédigé en bon français	0
2.	Le manuel est-il à jour?	1

3. Les informations s'appliquent-elles à l'instrument en question? 2

4. Y a-t-il une section pour la révision, l'utilisation, la réparation et l'entretien? 1

5. Identification : Y retrouve-t-on les informations suivantes:

a)	modèle	2
b)	nom, adresse et numéro de téléphone du manufacturier	1
c)	nom, adresse et numéro de téléphone du représentant	0
d)	nom, adresse et numéro de téléphone du centre de réparation le plus proche	1
e)	tableau pour inscrire le numéro de série, modification, date d'achat, etc.	0

6. Caractéristiques de la pompe: Y retrouve-t-on les informations suivantes:

DESCRIPTION

a)	plage d'utilisation	2
b)	qualificatif du débit (volumique ou massique)	2
c)	conditions environnementales d'utilisation	2
d)	bloc d'alimentation/capacité	2
e)	type de chargeur	0
f)	approbation sécuritaire	2
g)	garantie	1 *
h)	caractéristique particulière	2
i)	description du système pneumatique	2
j)	description du système électrique	2
k)	schéma pneumatique	2

* Il n'y a pas de section sur la garantie.

7. Utilisation et entretien

a)	liste des outils et matériaux nécessaires	0
b)	procédure de révision et schéma de montage	0
c)	procédure d'étalonnage et schéma de montage	1
d)	procédure d'entretien	1
e)	liste des accessoires optionnels	2
f)	procédure d'utilisation des accessoires	2

8. Dépannage et/ou réparation

a)	procédure de dépannage et/ou réparation	0
b)	schéma physique	2
c)	schéma électrique /électronique	0
d)	liste des pièces de rechange	2
	TOTAL:	37

Résultats:

_____	excellent (54 points et plus)
X	satisfaisant (36 à 53 points)
_____	pauvre (35 points et moins)

On retrouve ci-après quelques remarques et/ou corrections dans les différentes sections du manuel d'utilisation:

- Spécifications:

p.4 : la plage d'utilisation à bas débit est de 1 à 750 mL/min et non 1 à 500 mL/min.

: le rotamètre est gradué au 250 mL/min et non au 200 mL/min.

p.5 : l'indicateur "Flow fault" existe en mode haut débit seulement.

- Description:

p.12 : dans le paragraphe "Leaving the power control switch...", on devrait lire "Leaving the on/store switch (Figure 1, #8) in the ...".

- Operation:

p.13 : sur la touche "Flow and battery check", on devrait lire "Flow adjustment and battery check" car il n'y a aucun "Flow check".

p.14 : dans le paragraphe #4, on devrait lire Figure 1, #20 au lieu de Figure 1, #19.

- Preventive maintenance:

p.22 : dans le paragraphe Removal, rajouter après "the four case screws" le texte (Figure 1, #8).

p.25 : dans le paragraphe numéroté #2 et #3, on devrait lire (Figure 1, #12) au lieu de (Figure 1, #8).

- Figure 1:

p.30 : . #24 ce type de prise n'existe pas sur ce modèle
. rajouter le #26 aux vis qui attachent ensemble le devant et derrière de la pompe.
. #18 mauvaise échelle sur rotamètre.

p.31 : . rajouter "#26 Fastens front and rear case".

4. CONCLUSION/RECOMMANDATIONS

La pompe SKC 224-PCXR7 rencontre dans l'ensemble la majorité de nos critères d'acceptabilités. Elle possède de plus des caractéristiques intéressantes de programmation qui peuvent s'adapter à différentes situations d'échantillonnage.

Son utilisation devra cependant se limiter à des milieux où les variations de température ne sont pas trop importantes car le débit de la pompe varie avec la température de l'air. Les variations de température doivent être inférieures à 10°C si on ne veut pas que le débit déroge de 5 % du point d'ajustement.

Le courant d'appoint sur les chargeurs (simple et multiple) devrait être abaissé entre C/80 et C/100 (C étant la capacité) afin de ne pas diminuer prématurément le temps de vie des blocs d'alimentation.

Un contrôle de qualité plus sévère de la part du manufacturier assurerait au client un produit qui rencontre la totalité de ses spécifications (ex: compensation du débit versus la chute de pression, minuterie du chargeur simple).

5. RÉFÉRENCES

Larivière, P. et Laliberté, L. "Procédure d'évaluation de pompes personnelles d'échantillonnage", Étude technique T-9, Montréal, IRSST, (1987).

ANNEXE I

Livre d'instruction de la pompe SKC modèle 224-PCXR7

OPERATING INSTRUCTIONS
UNIVERSAL FLOW SAMPLE PUMP
MODEL 224-PCXR7

UNIVERSAL FLOW SAMPLE PUMP

Model 224-PCXR7

OPERATING INSTRUCTIONS

SKC Inc.
334 Valley View Road
Eighty Four, PA 15330, USA

FORM 3764-REV702

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A. DESCRIPTION

INTRODUCTION

The PCXR7 represents the culmination of two years of extensive research and development. It incorporates the first "on-board" computer, specially designed for ease of operation and the broadest flexibility ever offered in a portable sampler. Truly "state-of-the-art." In addition, the new high technology pneumatic system is the most energy efficient we've ever introduced. The result: unbeatable flow, back pressure, and run-time capabilities.

The PCXR7 is manufactured to the highest quality standards and will afford trouble-free operation when used in accordance with this manual. Please read carefully. It has been specifically designed for "on worker" and "fence line" applications in conjunction with sample collecting devices including filters, impingers, sampling tubes and color detector tubes.

State of the art Electronics - Powerful Pneumatics - Uncompromising Quality. The PCXR7 truly sets the new standard of excellence.

FEATURES

* LCD Display
* Keyboard Control with Anti-tamper Cover
* Intermittent Sampling Capability Reduces Required Number of Samples
* 8 Hour TWA Test Now Possible
* Extended TWA Sampling up to 7 Days
* Automatic Timed Delayed Start
* Automatic Timed Shutdown
* Interrupt "Hold" Feature
* Total Time and Run Time Display
* High Accuracy Timer
* Broad Range - One to 5000 ml/min
* Handles Back Pressures to 40" Water Over Most Used Flow Ranges
* Constant Flow
* Pulsation-Free Flow
* Built-in Flow Indicator
* Multi-Low Flow Sampling Capability
* Fault Features
  Lo Battery Shutdown
  Pinched Hose Shutdown
  Excess Back Pressure Shutdown
* Fault Shutdown with Time Retention
* Battery Charge Test
* Ultra Quiet Operation
* Heavy-Duty Inpact-Resistant Case
* Replacement Parts in Preassembled Modules
* UL Listed Intrinsically Safe (Class 1, Groups A, B, C, D; Class II, Groups E, F, G; and Class III)

FEATURES (Continued)

* Comprehensive One-Year Warranty
* Built-in Fluid/Particulate Trap
* External See-Through Filter Housing
* Stainless Steel Belt Clip
* External Exhaust Port
* Anti-Tamper Compensation Adjustments
* Easily Accessible Compensation Adjustments

SPECIFICATIONS

OPERATING RANGE:	1-5000 ml/min (1-750 ml/min REQUIRES LOW FLOW CONTROL)
WEIGHT:	34 oz.
DIMENSIONS:	1-15/16" x 4-11/16" x 5-1/8"; 44.7 cubic inches (732 cubic centimeters)
COMPEN-SATION RANGE:	750 ml/min - 5" to 40" Water Back Pressure 1000 ml/min - 0" to 40" Water Back Pressure 2000 ml/min - 0" to 40" Water Back Pressure 2500 ml/min - 0" to 40" Water Back Pressure 3000 ml/min - 0" to 35" Water Back Pressure 4000 ml/min - 0" to 20" Water Back Pressure 5000 ml/min - 0" to 15" Water Back Pressure
FLOW CONTROL:	±5% Set Point Constant Flow
RUN TIME:	8 hours minimum at 4000 ml/min and 20" water back pressure
FLOW INDICATOR:	Built in Flow Indicator with 200ml division; scale marked at 1, 2, 3, 4, & 5 LPM

SPECIFICATIONS (Continued)

BATTERY ASSEMBLY:	Plug in battery pack, Rechargeable NiCad 2.0 AH, 6.0 V. U/L Listed. Contains receptacle for charging out of pump.
INTRIN-SICALLY SAFE:	UL Listed for Class I, Groups A, B, C, D; Class II, Groups E, F, G; and Class III. Temp Code T3C.
OPERATING TEMP:	-20°C to +45°C (-4°F to +113°F)
STORAGE TEMP:	-40°C to +45°C (-40°F to +113°F)
CHARGING TEMP:	+5°C to +45°C (+41°F to +113°F)
OPERATING HUMIDITY:	0 to 95% Relative
FLOW FAULT:	Fault shutdown with LCD Indicator and Time Display Retention if flow is restricted.

SPECIFICATIONS (Continued)

BATTERY TEST: LCD Indicator verifies battery condition prior to test.

TIME DISPLAY: LCD Indicator displays time in minutes (Sampler run time, sampling period elapsed time or total elapsed time including delayed start time).

DELAY ON: Allows user to select minutes to delay start of test up to 9999 minutes (7 days).

TIMED SHUTDOWN: Allows user to select minutes of operation before automatic shutdown

TIMING ACCURACY: ± .05% (± 45 seconds/day)

INTER-MITTENT SAMPLING: Programmable to allow user to extend short term samples over an extended period of time to meet time weighted average requirements with a reduced number of samples. Elapsed time maximum is 9999 minutes (7 days).

SPECIFICATIONS (Continued)

SAMPLING PAUSE: Allows user to temporarily halt sampling without loss of timing or programming data. Restart does not require resetting time.

MULTIPLE SAMPLING: Built in constant pressure regulator allows user to take up to four simultaneous samples of up to 750 ml/min each (total combined flow 1350 ml/min maximum) using optional low flow control.

ADDITIONAL SPECIFICATIONS:

* Built in fluid/particulate trap
* External see-through filter housing
* Anti-tamper control cover
* Anti-tamper compensation adjustments
* Accessory mounting provisions
* Stainless steel belt clip
* External exhaust port
* All non-plastic parts made of corrosion resistant materials

DESCRIPTION (Continued)

PNEUMATIC SYSTEM

The pneumatic system consists of five basic assemblies: 1) Pump/Valve, 2) Pulsation Dampener, 3) Pressure Regulator, 4) Flowmeter, and 5) Filter Assembly.

1) Pump/Valve Assembly: The Pump is of a dual silicone diaphragm design, driven by a high efficiency DC motor. The diaphragm pump is combined with special low pressure, positive acting valves. The pump mechanism is sealed to prevent dirt from entering. The DC motor operates from rechargeable NiCad Batteries, described in detail later.

2) Pulsation Dampener Assembly: Consists of a pair of silicone diaphragms within a housing. Two such assemblies are used to maintain pulsation-free flow and are located directly above the pump. In the intake stroke, the diaphragms are stretched inward by vacuum. In the exhaust stroke, the diaphragm elasticity forces the diaphragms apart, maintaining a continuous vacuum on the intake to the pump.

3) Pressure Regulator Assembly: This is used for low flow sampling from 1 to 750 ml/min. The purpose of the Regulator is to maintain 20 inches of water across a control restrictor. In high flow applications (750 ml/min and

up), the Regulator is not used. The Regulator consists of the sensing diaphragm with a pre-loaded spring that automatically opens or closes an air intake valve to recycle the air within the pump. When the Regulator is in the system, 20 inches of water pressure causes the Regulator to open and maintain that pressure. A manual valve is provided to connect the Regulator in or out of the system, as needed. It is located below the knurled cap screw (19) in Figure 1. The control of the Regulator is adjusted through opening screw under (21) in Figure 1. It is set at the factory for 20 inches of water and should not be tampered with except for service. A hex-head cap screw (Figure 1, #21) is used so that it may not be mistaken for the regulator valve (Figure 1, #19).

4) Flowmeter: This is a rotameter style flowmeter mounted vertically in the case. It is used to monitor the pump flow. Rotameters are not high precision flowmeters and should be backed up and set with a more precise film flowmeter. However, they are very repeatable and once the correct values have been established, they are very useful for setting the pump flow on a routine basis.

DESCRIPTION (Continued)

5) Filter Assembly: Consists of a see-through housing and filter membrane held in place by an "O" ring. All air passes through the filter assembly. The transparent housing permits the operator to view the pump filter to determine when changing is necessary. (See Preventive Maintenance.)

ELECTRICAL SYSTEM

The electrical control system consists of 1) the Battery Pack, 2) the Control Panel, 3) an Advanced Motor Control Circuit, and 4) an on-board computer.

1) Battery Pack: Consists of five NiCad cells in series to provide 6.Ø volts at 2.Ø AMP hour capacity to the Sampler. The pack is intrinsically safe and should be replaced only with U/L listed battery pack (SKC Catalog No. 224-3Ø). IMPORTANT! See Battery Maintenance section for proper care of battery packs.

2) Control Panel: Consists of a) an LCD display for readout of battery condition, total elapsed time, pump run time, sampling period time, test status and set-up status, and b) a keyboard control pad for inputting sampling parameters and checking test status.

DESCRIPTION (Continued)

3) Motor Control Circuitry: a) Constant Flow System - The Constant Flow System provides for constant air flow even though the back pressure of the collecting device may have increased, such as caused by dust accumulation on a filter. As the back pressure increases, the motor voltage is automatically corrected to maintain constant flow over the operating range.

b) Automatic Sampler Shutdown with Flow Stoppage or Low Voltage: If the collecting device used in conjunction with the pump should become plugged or the tubing pinched, the pump will automatically cut off. When this occurs, the pump will automatically go into "hold" mode. Total sampling period time will be displayed. Pump run time may be read by depressing "pump run time" key. Total elapsed time including delayed start may be read by pressing "Total Elapsed Time" key.

4) A specially designed on-board computer controls the timer with delayed start and intermittent sampling options: A timer is provided and will stop the pump after a preset number of minutes of run time, up to 9999 minutes. The user may also program a start test delay of up to 9999 minutes. In addition, the user may program a total sampling period in excess of the pump run time. Total sampling period may also be up to 9999

DESCRIPTION (Continued)

minutes. The on-board computer will automatically control the pump run time so that the sample is taken intermittently over the desired total sampling period, thus allowing TWA samples to be collected using fewer samples.

Leaving the power control switch in the "on" position allows the program to be run repeatedly by simply pressing the "set-up" key then the "start" key at the beginning of each test cycle. When storing the sampler for extended periods of time (in excess of one month) the power control switch should be moved from the "on" position to prevent over-discharging of the battery pack.

B. OPERATION

1. HIGH FLOW APPLICATIONS (750-5000 ml/min)

Refer to Figure 1, page 30

1) Charge unit for a minimum of 14 hours by connecting charger plug to Sampler charging jack (Figure 1, #24).

```
*****************************************
*      CAUTION! DO NOT CHARGE IN        *
*       A HAZARDOUS ENVIRONMENT.        *
*    USE ONLY SKC APPROVED CHARGER      *
*      DESIGNATED FOR THIS MODEL.       *
*****************************************
```

2) Test the battery pack for full charge by turning the sampler on using "ON" switch (Figure 1, #8). Press the "Hold" key then the "Flow and Battery Check" key. Adjust the flow to 2 liters/minute using the flow adjustment control (Figure 1, #12 & 18). The LCD Display should indicate "battery OK" in the upper left-hand corner.

3) While in the battery test mode, connect calibrated flowmeter to filter housing intake (Figure 1, #14) using 1/4" tubing. Set Sampler to desired flow with flow adjustment control (Figure 1, #12). After completing the battery test and flow adjustment, press the "Flow and Battery Check" key to halt the sampler.

4) Connect the sampling media tubing to filter housing intake (Figure 1, #14). (For pressure applications, insert exhaust port fitting into exhaust port (Figure 1, #19) to make connection to exhaust port).

CAUTION! Impinger sampling requires in-line trap to prevent liquid fumes from accidentally being drawn into the Sampler. Single or dual impinger/trap holders may be mounted directly to the face of the Sampler using accessory mounting screws (Figure 1, #13).

****
* FAILURE TO USE THE TRAP VOIDS *
* THE WARRANTY. *
****

5) While the pump is displaying "HOLD" on the LCD Display, the timing functions may be set. Press the "Set-up" key. "Delayed Start" will display on the LCD as well as a flashing digit. The value of the flashing digit will be incremented each time the "Digit Set" key is pressed. The "Digit Select" key is used to move the flashing digit. Using the "Digit Select" and Digit Set" keys, enter the desired number of minutes delay before the sample period is to begin. Once the correct number of minutes is displayed, press the "Mode" key. "Sample Period" will now be displayed. Again, using the "Digit Select" and "Digit Set" keys as above, enter the desired total sampling period time in minutes. The total sampling

period is the total length of time over which the test is to be made and not the actual run time of the pump. If intermittent sampling is not desired, set the sample period equal to the pump run time. Press the "Mode" key when finished. "Pump Period" will now display. This is the actual number of minutes you wish the pump to run before automatically shutting down. Again, using the "Digit Select" and Digit Set" keys as above, enter the desired pump run time. If the pump run-time is less than the sampling period entered, the computer will automatically calculate and control the on/off cycling to complete the pump run-time in the time allotted. After completing, you may scan through your program by repeatedly pressing the "Mode" key. Each setting will display.

6) Start the test cycle by pressing the "Start/Hold" key at the beginning of the desired sampling period. The "Delayed Start" indicator will flash and the "Time" indicator will display the amount of time remaining until the sampling cycle starts if a time delay has been programmed. "Sample running" will display when the delay sequence has ended. The time display will automatically track the sampling period time elapsed.

7) Once the sampling period has begun, the user has the following options:

a) Normal shutdown - the Sampler will stop and the "sample over" indicator will light when the time set on the programmable timer has been reached.

b) Fault shutdown - if the flow becomes exessively restricted or the battery voltage drops below required level, the Sampler will shut down. The "Hold" indicator will light and the timing functions will freeze. Either the "Lo Battery" or the "Fault" indicator will light, depending on the cause of the shutdown. (In the case of flow fault or blockage, the test may be resumed if desired by correcting the flow blockage and pressing the "Start/Hold" key.

c) Pause - the Sampler will pause by pressing the "Start/Hold" key. All timing data will freeze. To resume sampling, again press the "Start/Hold" key.

d) Early shutdown - the Sampler may be shutdown at any time with no loss of stored time data by pressing the "Start/Hold" key.

e) The time indicator continuously displays the elapsed sampling period. The pump run time may be displayed at any time by pressing the "Pump Run Time" key. The total elapsed time (including the delayed start) may be displayed at any time by pressing the "Total Elapsed Time" key.

2. LOW FLOW APPLICATIONS (1-750 ml/min)

Refer to Figures 1 and 2, pages 30 - 32.

1) Charge unit for a minimum of 14 hours by connecting charger plug to Sampler charging jack (Figure 1, #24).

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*****************************************
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*    USE ONLY SKC APPROVED CHARGER      *
*      DESIGNATED FOR THIS MODEL.       *
*****************************************
```

2) Test the battery pack for full charge by turning the sampler on using "ON" switch (Figure 1, #8). Press the "Hold" key then the "Flow and Battery Check" key. Adjust the flow to 2 liters/minute using the flow adjustment control (Figure 1, #12 & 18). The LCD Display should indicate "battery OK" in the upper left-hand corner.

3) Adjust the flow to 1.5 LPM (Figure 1, #12 & #18). NOTE: the flow is not critical but must exceed the combined sampling flows by at least 150

ml/min. After completing the battery test and flow adjustment, press the "Flow and Battery Check" key to halt the sampler.

4) Remove the protective cap covering the regulator shutoff cap screw (Figure 1, #19). Using the large screwdriver supplied, open the regulator shutoff valve by turning the adjustment screw 3 turns counter-clockwise. Replace the protective cap.

5) Connect an adjustable flow holder (Figure 2) using tubing supplied to the filter housing intake (Figure 1, #14).

6) Break the tips off the sample tube(s) to be used. IMPORTANT! 2.5mm opening minimum in each end of tube required. Place tube(s) in the manifold's rubber connector with the arrow pointing toward the manifold.

CAUTION! Long duration color tubes require a special tube cover (see Optional Accessories) which allows the addition of an inline trap tube. Long duration color tubes outgas caustic funes which must be trapped to prevent damage to low flow manifold and Sampler.

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* FAILURE TO USE THE TRAP VOIDS *
* THE WARRANTY. *
****

7) Connect calibrated flowmeter (see Optional Accessories) to the exposed end of the sample tube(s). Loosen the anti-tamper cover on the manifold to expose the manifold's flow adjustment screw(s). Turn on the Sampler and turn the manifold's flow adjustment screw(s) until the desired flow rate is obtained. Turn off the Sampler and place the protective covers over the sample tubes.

8) While the pump is displaying "HOLD" on the LCD Display, the timing functions may be set. Press the "Set-up" key. "Delayed Start" will display on the LCD as well as a flashing digit. The value of the flashing digit will be incremented each time the "Digit Set" key is pressed. The "Digit Select" key is used to move the flashing digit. Using the "Digit Select" and Digit Set" keys, enter the desired number of minutes delay before the sample period is to begin. Once the correct number of minutes is displayed, press the "Mode" key. "Sample Period" will now be displayed. Again, using the "Digit Select" and "Digit Set" keys as above, enter the desired total sampling period time in minutes. The total sampling period is the total length of time over which the test is to be made and not the actual run time of the pump. If intermittent sampling is not desired, set the sample period equal to the pump run time. Press the "Mode" key when finished. "Pump Period" will now display. This is the actual number of

minutes you wish the pump to run before automatically shutting down. Again, using the "Digit Select" and Digit Set" keys as above, enter the desired pump run time. If the pump run-time is less than the sampling period entered, the computer will automatically calculate and control the on/off cycling to complete the pump run-time in the time allotted. After completing, you may scan through your program by repeatedly pressing the "Mode" key. Each setting will display.

9) Start the test cycle by pressing the "Start/Hold" key at the beginning of the desired sampling period. The "Delayed Start" indicator will flash and the "Time" indicator will display the amount of time remaining until the sampling cycle starts if a time delay has been programmed. "Sample running" will display when the delay sequence has ended. The time display will automatically track the sampling period time elapsed.

1Ø) Once the sampling period has begun, the user has the following options:

a) Normal shutdown - the Sampler will stop and the "sample over" indicator will light when the time set on the programmable timer has been reached.

b) Pause - the Sampler will pause by pressing the "Start/Hold" key. All timing data will freeze. To resume sampling, again press the "Start/Hold" key.

c) Early shutdown - the Sampler may be shutdown at any time with no loss of stored time data by pressing the "Start/Hold" key.

d) The time indicator continuously displays the elapsed sampling period. The pump run time may be displayed at any time by pressing the "Pump Run Time" key. The total elapsed time (including the delayed start) may be displayed at any time by pressing the "Total Elapsed Time" key.

C. PREVENTIVE MAINTENANCE

This section provides the user periodic maintenance tips on battery charging, air inlet filter checking and replacement and leak detection.

BATTERY PACK

Refer to Figure 1, page 30.

Removal - Remove the two screws (Figure 1, #22) which secure the battery pack (Figure 1, #23) to the case front and loosen the four case screws above and below the belt clip. Carefully slide the battery pack out to the right from under the belt clip (Figure 1, #25) being careful not to cock it at an angle. Edge rails should guide pack out.

Replacement - Stand the pump vertically on a flat surface. Slip the front edge of the battery pack (Figure 1, #23) under the belt clip (Figure 1, #25) and rotate the battery pack so the rails engage the slots on the case front. Push the battery pack to the left until it is properly located and reinstall screws (Figure 1, #22) and tighten the case screws.

Battery "Memory Effect" - The NiCad battery pack supplied with the SKC Sampler should be completely discharged from time to time to minimize the potential for "memory effect" which occurs frequently with rechargeable batteries. "Memory effect" is a

characteristic of all NiCad cells and prevents the batteries from fully recharging, even though a full charge is indicated. This would prevent the pump from running a full 8 hour sample period in some instances. Approximately every 10 recharges:

1. Turn on pump using the "ON" switch (Figure 1, #8).
2. Set flow rate to 3 liters/minute with no load on intake port.
3. Allow pump to run until fault circuit cuts pump off. "Lo Battery" indicator should light.
4. Turn pump off and charge battery for a full 14 - 16 hours.
5. After charging, check battery by pressing the "Battery Check" key with the flow set to 1 - 2 liters/minute, to assure battery has received charge. "Battery OK" indicator will light indicating full charge.

NOTE: After several hundred rechargings, NiCads lose performance characteristics and should be discarded if pack fails to hold charge.

Spare Battery Packs/Infrequent Use - NiCad batteries may not provide full current capacity if left unused over extended periods of time. Rotate the use of any spare pack to avoid idle periods in excess of one month. Fully charge packs before or after use or storage.

****
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****

PUMP INLET FILTER

The SKC Sampler is fitted with a filter/trap inside the clear plastic intake port housing. This prevents particulates and liquids from being drawn into the pump mechanism. Occasional attention should be taken to assure that the filter is not becoming clogged and creating an excessive load on the pump. If it is determined that maintenance is necessary: (Refer to Figure 1)

1. Blow all dust and debris from around the filter housing.
2. Remove the four screws (Figure 1, #15) and the front filter housing.
3. Remove and discard the filter membrane (Figure 1, #17) and "O" ring (Figure 1, #16).
4. Clean the removed filter housing.
5. Insert a new filter membrane and "O" ring per Figure 1. (Filter Replacement Kit, SKC Catalog No. 224-09)
6. Insert the four screws (Figure 1, #15) and cross tighten secured to rear housing within is the case.

SETTING THE FLOW COMPENSATION

Refer to Figure 1, page 30.

NOTE: Compensation is factory preset to cover the most common range of NIOSH/OSHA tests. It is necessary to reset the compensation only if: 1) non-factory repairs have been made, or 2) greater precision is desired at a particular flow rate.

1) To set the flow compensation, remove the anti-tamper cover screws on the side of the sampler (Figure 1, A and B).

2) Set the sampler flow rate to 1000 ml/minute using the flow adjustment control (Figure 1, #8). Allow approximately 10 seconds to stabilize. Apply 25" water back pressure to the inlet of the sampler and note the change in flow on the flowmeter (Figure 1, #18) or external flow calibrator. If the flow increases, turn the conpensation adjustment pot "A" (located throught the hole vacated by the anti-tamper screw) clockwise until a flow rate of 1000 ml/min obtained. If the flow decreases, turn the compensation adjustment pot "A" slightly counterclockwise until a flow rate of 1000 ml/min is obtained.

3) Set the sampler flow rate to 2500 ml/minute using the flow adjustment control (Figure 1, #8). Allow approximately 10 seconds to stabilize. Apply 25" water back pressure to the inlet of the sampler and note the change

in flow as above. If the flow increases, turn the compensation adjustment pot "B" (located through the hole vacated by the anti-tamper screw) counterclockwise slightly, which will further increase the flow. If the flow decreases, turn the compensation pot "B" clockwise slightly to further decrease the flow. Remove the back pressure and repeat step 3 until the change of flow is within 5%.

4) At this point, repeat steps 2 and 3 since there is interaction between the compensation pots. Replace the anti-tamper cover screws. NOTE: if the most precision is desired at a particular flow setting, the above procedure may be used at that setting. For this purpose, it is helpful to note that compensation pot "A" has the most effect at lower flow rates and compensation pot "B" has the most effect at higher flow rates.

SETTING PRESSURE REGULATOR (Low flow mode)

Refer to Figures 1 and 2, pages 30 - 32.

Turn the "ON" switch to "ON". Adjust the flow adjustment control (Figure 1, #12) to 1.5 liters/min. Remove the protective cap screw (Figure 1, #19). With a screwdriver, open the Pressure Regulator shutoff valve located under cap screw (Figure 1, #19) by turning it counterclockwise three turns.

This now places the Pressure Regulator into the pump system. CAUTION: Pressure Regulator shutoff valve must be open else water will be pulled into the pump and damage will occur. A trap is desirable to prevent this from occurring accidentally. The trap must be positioned in line between the pump and manometer. Connect the pump intake port directly to the trap and a water manometer that is at least 36" in length. Remove the protective cap screw (Figure 1, #21) and adjust the pump suction pressure to 20" water by turning Pressure Regulator Adjust Screw located under cap (Figure 1, #21) clockwise to increase pressure and counter-clockwise to decrease pressure. The pump is now set for low flow operation between 1 and 750 cc/min. The pump may be set exactly for any specific flow by using the Low Flow Control (SKC Catalog No. 224-26-01, -02, -03, -04). (See Optional Accessories)

To return the pump to high flow operation, turn the regulator shutoff screw clockwise until it stops and Replace the protective cap screw.

NOTE: SKC U/L Battery Packs (SKC Catalog No. 224-30) contain a protective device to eliminate potential short circuiting while the pump is in use. If the charger's red charging light is on prior to attachment to the battery pack, the charger is defective and must not be used. If the red charging light on the charger does not light while charging,

the charging circuit is open either in the pack or charger unit, or the wall outlet is inoperative. Process of elimination should indicate which unit is defective. If you are unable to determine which is defective, please contact SKC's Customer Service Department (412-941-9701) for further assistance.

****
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****

D. OPTIONAL ACCESSORIES

Adjustable Flow Holders:

224-26-01	Single Holder
224-26-02	Dual Holder
224-26-03	Tri Holder
224-26-04	Quad Holder

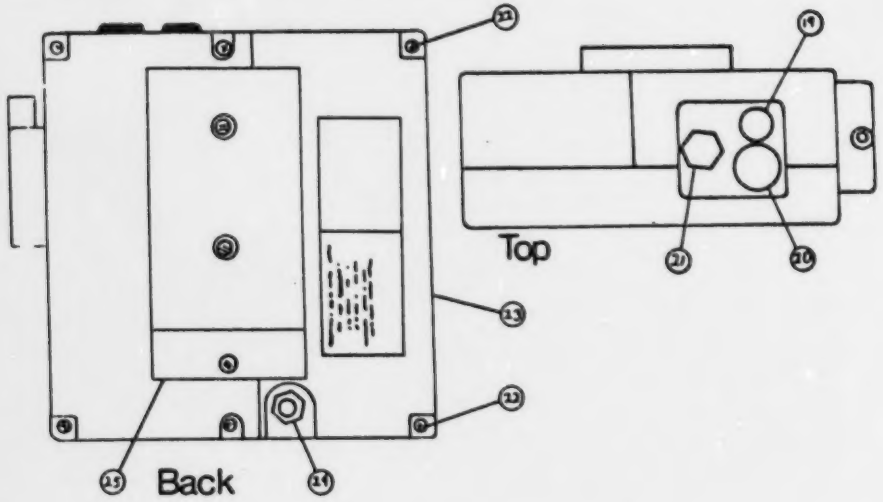
Protective Covers:

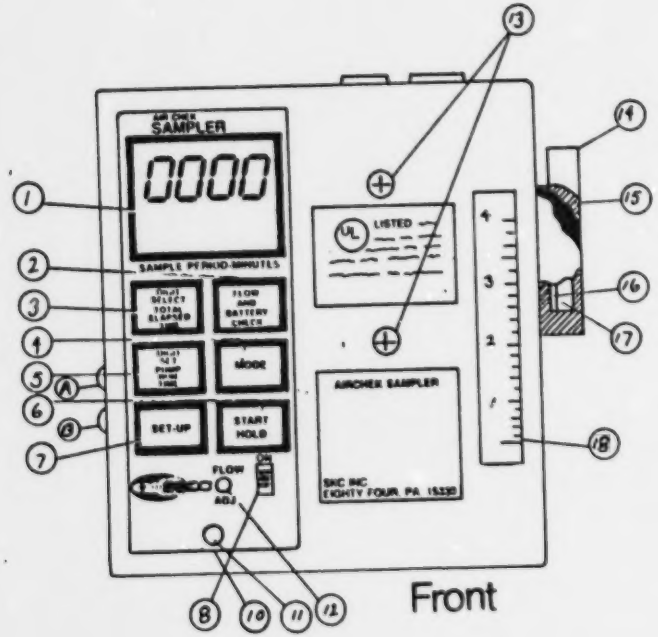
224-28A	NIOSH Charcoal, standard tubes 6mm OD x 70mm length
224-28B	Standard tubes 8mm OD x 110mm length
224-28C	Standard tubes 10mm OD x 150 mm length
224-28D	Standard tubes 10mm OD x 220mm length and shorter tubes
224-28T	Color Detector Tube Holder - 15mm OD x 115mm primary tubes, 15mm OD x 55mm back-up tubes

Battery Chargers:

224-31	Single Battery Charger 115V
224-31B	Single Battery Charger 230V
224-31SCR	Deluxe Battery Charger - Dual Rate, Auto Switching, 115V
224-31SCR	Deluxe Battery Charger - Dual Rate, Auto Switching, 230V
224-32	5 Pump Multiple Battery Charger 115V
224-32B	5 Pump Multiple Battery Charger 230V
224-32SCR	Deluxe 5 Station Battery Charger, Auto Switching, 115V
224-32SCRB	Deluxe 5 Station Battery Charger, Auto Switching, 230V

Figure 1 - Model 224-PCXR7





E. DIAGRAMS/GLOSSARY

Figure 1 - Model 224-PCXR7

NO.	DESCRIPTION	FUNCTION
1	LCD Display	Indicators for all sampler functions
2	Flow and Battery Check Key	Allows setting flow rate and testing battery condition
3	Digit Select/Total Elapsed Time Key	Allows selecting which time digit is being set when in set-up mode or viewing total elapsed time during the actual sampling cycle
4	Mode Key	During set-up allows changing between delayed start, pump run time and total elapsed time
5	Digit Set/Pump Run Time Key	Allows setting the flashing digit to the desired value or viewing the actual pump run time during the actual sampling cycle
6	Start/Hold Key	Used when ready to begin the sampling cycle, pause the sampling cycle and restart the cycle after pause
7	Set-up Key	Allows setting the delayed start time, pump run time and total elapsed time desired
8	"ON/STORE" Switch	Allows the pump to be shut down completely for long periods of storage (over 30 days)
10	Anti-tamper cover	Protects controls from incidental contact or tampering
11	Cover Screw	Fastens anti-tamper cover
12	Flow Adjustment Control	Adjusts flow from 750-5000 ml/min
13	Accessory Mounting Screws (2)	Secure accessories such as impinger and trap holders
14	Filter Housing (intake)	Air intake port and trap
15	Screws (4)	Secure filter housing
16	Filter O-ring	Positive leak seal for filter in housing
17	Filter (10 micron nylon)	Filters particulates before entering pump
18	Built-in Flowmeter	Monitors for flow changes
19	Regulator Shut-off Cap Screw	Accesses regulator shut-off valve
20	Discharge Air Cap Screw	Accesses Exhaust Port
21	Regulator Adjustment Cap Screw	Accesses regulator pressure adjust
22	Battery Pack Screws (2)	Secures pack to pump
23	Battery Pack Assembly	Provides power to pump
24	Charging Jack	Connector for battery charger
25	Belt Clip	Secures Pump to worker
A	Compensation Pot A Anti-tamper Cover	Protects compensation pot A from accidental adjustment
B	Compensation Pot B Anti-tamper Cover	Protects compensation pot B from accidental adjustment

Adjustable Flow Holder

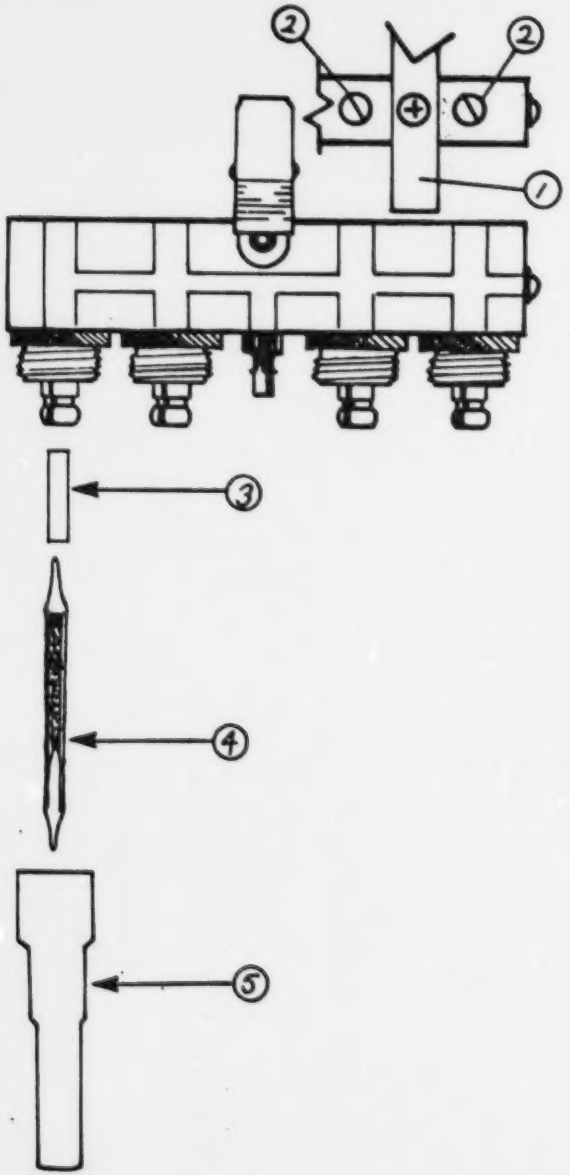
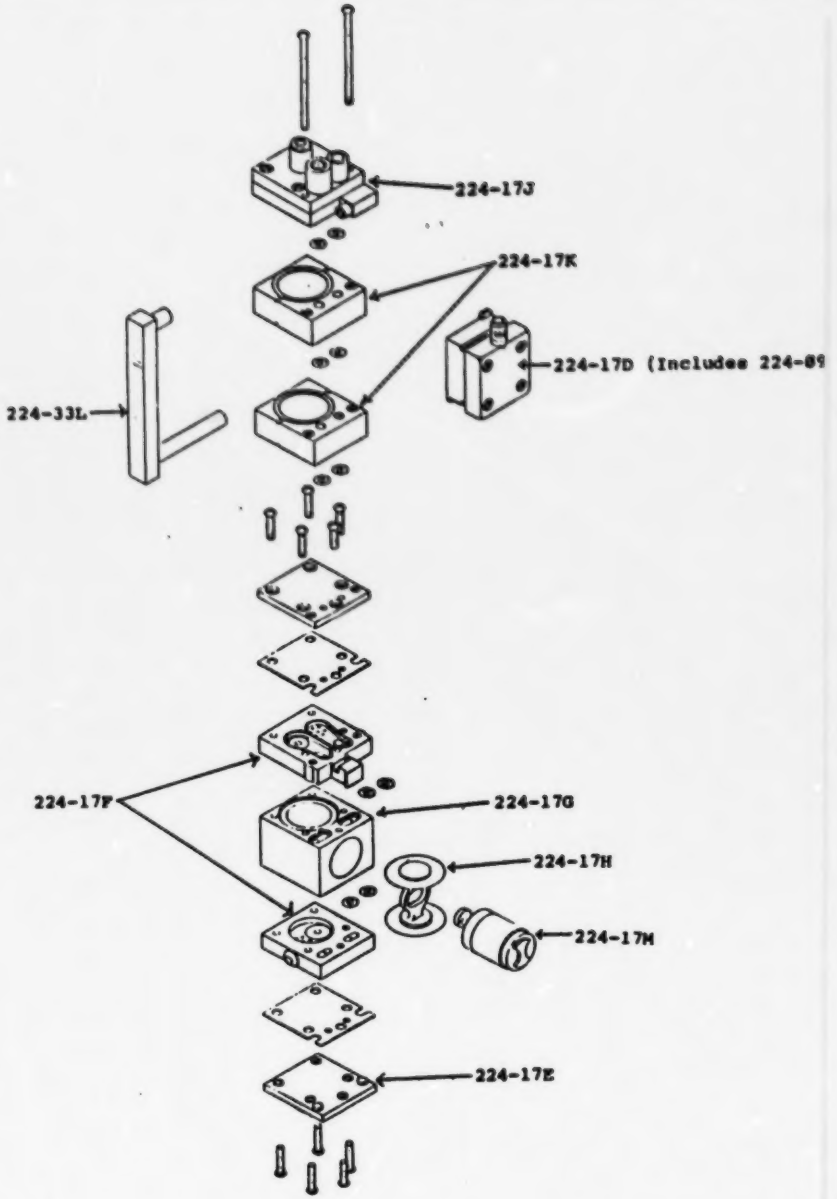


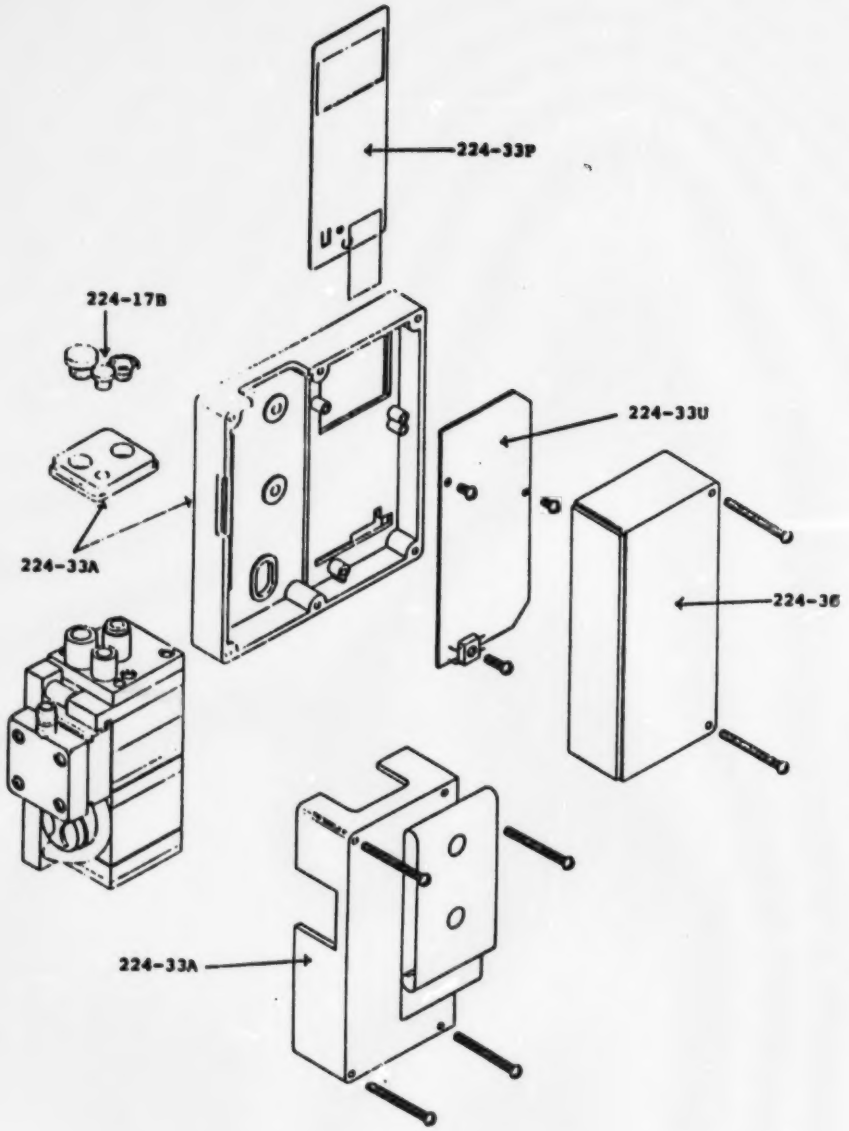
Figure 2 - Adjustable Flow Holder

NO.	DESCRIPTION
1	Anti-tamper Cover
2	Manifold Flow Adjustment
3	Rubber Connector
4	Sorbent Sample Tube
5	Protective Cover

Figure 3 - Replacement Parts

224-Ø9	Replacement Filter Kit
224-11	Sampler Tool Kit
224-17B	Cap Screws (set of 3)
224-17C	Exhaust Port Fitting
224-17D	Filter Housing Assembly
224-17E	Pressure Switch Assembly
224-17F	Valve Plate Assembly
224-17G	Pump Body
224-17H	Diaphragm/Yoke Assembly
224-17J	Regulator Assembly
224-17K	Pulsation Dampener Assembly (set of 2)
224-17M	Motor/Eccentric Assembly
224-3Ø	Battery Pack Assembly
224-33A	Case Parts (Excluding Battery Case)
224-33L	Flowmeter Assembly
224-33P	Keyboard Assembly
224-33U	Control Board





UNDERWRITERS LABORATORIES INC.
333 PFINGSTEN ROAD · NORTHBROOK, ILLINOIS 60062

an independent, not-for-profit organization testing for public safety

CERTIFICATE No. Ex.110287-62011
11 February 1987

Issued to:

SKC Inc..
R. D. 1 No. 395 Valley View Rd.
Eighty-Four, PA 15330
U.S.A.

This is to certify that: Intrinsically safe portable air pumps, Models 224-PCXR3, 224-PCXR7 and 224-43XR, when used with the self-contained 6.0v battery pack, SKC Model 224-30 has been investigated by Underwriters Laboratories Inc. in accordance with the standard indicated in this certificate.

UL Standard for Safety:

ANSI/UL/NFPA 4913-1979 (UL913-1979) Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations.

The Air Sampling Pumps comply with the requirements as defined by the standard indicated in this document for intrinsically safe equipment for use in Class I, Groups A,B,C, and D and Class II, Groups E, F and G and Class III hazardous locations.

To establish that a product is under the Certification program it is necessary to determine that the product has been manufactured under UL's Follow-Up Service. The Listing Mark of Underwriters Laboratories Inc. on the product is the only method provided by UL to identify a product manufactured under its Follow-Up Service. The Listing Mark includes the symbol of Underwriters Laboratories Inc. " Ⓤ " together with the word "Listed" and the control number 124U.

Code: Intrinsically safe: Class I, Group A, B, C and D and Class II, Groups E, F and G and Class III, Temperature Code T3C.

Tamb= 40C

Albert A. Bartkus
Associate Managing Engineer
Hazardous Locations
Casualty and Chemical
Hazards Department

Investigation and Test
Report Reference:
E62011, 20 January 1987

Look For The Ⓤ Listing or Classification Mark On The Product

UNDERWRITERS' LABORATORIES INC.

LISTING OR CLASSIFICATION AND FOLLOW-UP SERVICE

The promulgation of UL Listing or Classification is contingent upon the establishment of UL's Follow-Up Service, designed to serve as a check on the means which the manufacturer exercises to determine compliance of the product with UL's requirements. Under the Follow-Up Service, the manufacturer attaches labels, markers or other authorized evidences of Listing ("Listing Marks") or Classification ("Classification Markings") to such of his products as are found by him to be in compliance with UL's requirements. Representatives of UL make periodic examinations or tests of the products at the factory and may from time-to-time, select samples from the factory, the open market, or elsewhere, to be sent to a UL testing station for examination and or test to determine compliance with UL's requirements. Should examination or test by UL's representative disclose features not in compliance with the requirements, the manufacturer is required either to correct such items or to remove the Listing Mark or Classification Marking from the product.

The appearance of catalog or model numbers or other specific product designation on the Certificate signifies that samples of such products have been submitted to UL and found to comply with the applicable requirements and that the manufacturer has been authorized to use the appropriate Listing Mark or Classification Marking on production that continues to comply with the requirements. The manufacturer is not obligated to label all of his production, and products which do not bear the Listing Mark or Classification Marking are not required by UL to comply with UL's requirements. Accordingly, the appearance of a specific product designation on the Certificate does not in itself assure that products so specified or identified will be or have been produced under UL's Follow-Up Service. The manufacturers' products are not counterchecked under UL's Follow-Up program unless they bear the UL Listing Mark or Classification Marking. Only these products bearing the appropriate Listing Mark or Classification Marking and the company's name, trade name, trade-mark, or other recognized identification should be considered as covered by UL's Listing or Classification and Follow-Up Service.